

US EPA ARCHIVE DOCUMENT

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DATA EVALUATION RECORD

STUDY 6

CHEM 036101

Trifluralin

§163-2

FORMULATION--90--FORMULATION NOT IDENTIFIED

STUDY ID 40673601A

Parochetti, J.V. and E. R. Hein. 1973. Volatility and photodecomposition of trifluralin, benefin and nitalin. Weed Sci. 21:469-473.

DIRECT REVIEW TIME = 8

REVIEWED BY: L. Parsons

TITLE: Staff Scientist

EDITED BY: W. Martin
L. Mickley

TITLE: Staff Scientist
Staff Scientist

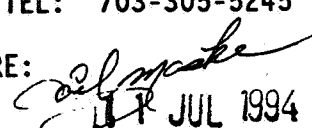
APPROVED BY: W. Spangler

TITLE: Project Manager

ORG: Dynamac Corporation
Rockville, MD
TEL: 301-417-9800

APPROVED BY: G. Maske-Love
TITLE: Chemist
ORG: EFGWB/EFED/OPP
TEL: 703-305-5245

SIGNATURE:


JUL 1994

CONCLUSIONS:

Mobility - Laboratory Volatility

This laboratory volatility study provides supplemental data. It cannot be used to fulfill the data requirement (163-2). These data were taken from published articles and were not originally designed to satisfy Subdivision N data requirements. Therefore, it is difficult to draw the conclusions needed for an environmental fate assessment. However, these data and other published volatility data submitted (MRID 40673601B, 40673601C, 40673601D, 40673601E, 40673601F, 40673601G) do indicate the following:

1. Volatility may be a major route of dissipation for trifluralin.
2. Trifluralin appears to volatilize (≈ 25 to 60% of applied in 11 days).
3. Data are needed to determine relative rate of dissipation due to volatility in relation to other routes of dissipation.

In the data submitted, the concentration of trifluralin in air and soil was not determined/analyzed for/or furnished. In addition, the application rate and material balances could not be confirmed and the concentration of trifluralin residues in the air could not be related to the concentration of trifluralin residues in the soil. Furthermore, the study was terminated before the pattern of decline of the test substance was established.

METHODOLOGY:

An aqueous solution (10 mL) of a "commercial formulation" of trifluralin (concentration and formulation not identified) was sprayed onto the surface of three soils (Table 1) at a nominal rate of 2.24 kg/ha; the soils were in metal containers (5.6 cm diameter, 4.5 cm height). The moisture content of the soil was adjusted to field capacity, and the incubation temperature was 40°C. The treated soil was placed inside a glass cylindrical chamber with air drawn through a charcoal filter and then into the chamber at 0.04 m³/hour. The air was then vented through a florasil column (14 cm x 22 mm). After 3 hours of incubation, the florasil column was removed and rinsed with methanol. The methanol solution was analyzed by GC with electron capture detection. Additionally, volatility was intensively measured from one soil, the Lakeland sand, at soil moisture contents of air dry and saturation, and at temperatures of 30° and 50°C. All experiments were conducted in triplicate.

DATA SUMMARY:

Trifluralin (formulation not specified), at 2.24 kg/ha, volatilized from three soils incubated at field capacity and 40°C. For the Lakeland sand, increasing soil moisture from air dry to field capacity appears to increase volatility at all temperatures. After 3 hours of volatilization from the Lakeland sand at 50°C, approximately 4.5% of the total applied trifluralin volatilized at 0% moisture; 25% and 24% volatilized from 8% and 12% moistures, respectively (reviewer estimated from Figure 3).

The reported vapor pressure of trifluralin was 1.1×10^{-4} mm Hg at 25°C; volatility and air concentrations of trifluralin were not reported.

COMMENTS:

1. The registrant did not determine the concentration of trifluralin in the air. The nominal application rate was not confirmed; all data were expressed as "% of herbicide lost in 3 hours". The actual air and soil concentrations of trifluralin apparently were not determined.

2. Soil samples were not analyzed for trifluralin. Therefore, the pattern of decline of trifluralin from the soil could not be measured. In addition, the application rate was not confirmed and the concentration of trifluralin in the air could not be related to the amount of trifluralin in the soil.
3. The study was terminated before a pattern of decline could be established. There was only one sampling interval, at 3 hours posttreatment, therefore, no half-life could be estimated.
4. The test substance was uncharacterized, other than indicating it was a "commercial herbicide formulation".
5. The efficiency of the florisil trapping solution was not reported.
6. The study authors stated that there was no significant difference in the volatility of granular trifluralin with increasing soil moisture, and that more trifluralin was lost from "sprayed" than from granular applications. Experiments with granular formulations were not described in the methodology; therefore, it was not possible to assess this statement.
7. This study also included information on two other pesticides, benefin and nitralin; photodecomposition of the three pesticides was discussed, as well. These portions of the study were not reviewed since they are not pertinent to Subdivision N guidelines.
8. This study is one of several published papers included as appendices to MRID 40673601 (Day, E.W. 1988. Laboratory and field volatility studies with trifluralin from soil. Laboratory Project ID. EWD8807). This document was submitted as an assessment of the potential inhalation hazard of trifluralin to exposed workers. Because this portion of the document contains summary data only and is not pertinent to Subdivision N guidelines, it was not reviewed; only the published papers in the appendices have been reviewed.
9. EFGWB prefers that [¹⁴C]residues in samples be separated by chromatographic methods (such as TLC, HPLC, and GC) solvent systems of different polarity, and that specific compounds isolated by chromatography be identified using a confirmatory method such as MS in addition to comparison to the R_f of reference standards.

In this study aliquots of the extracts were analyzed by GC only.

Table 1 Characteristics of the tree soils used in these studies taken from the Ap horizon.

Soil type	Moisture content		pH	Organic matter	CEC	Mechanical analysis		
	Field capacity	Saturation				Sand	Silt	Clay
Island sand	17.1	17.1	6.2	1.1	10.0	100	0	0
Hypericum	27.8	12.3	6.8	3.3	14.7	89	11	0
Shale clay	41.0		4.9	3.3	24.4	33	48	19

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STUDY AUTHOR(S)'S RESULTS AND/OR CONCLUSIONS
(INCLUDING PERTINENT TABLES AND FIGURES)

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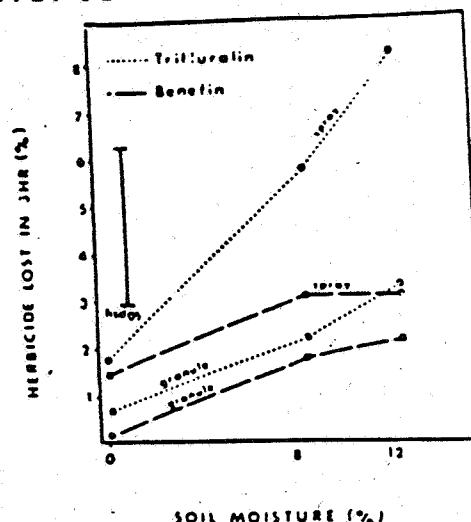


Figure 1. Trifluralin and benfen volatility from Lakeland sand at 30 C soil temperature as influenced by soil moisture and formulation.

period of the sprayed trifluralin from approximately 2 to 6% at a soil temperature of 30 C (Figure 1). Increasing soil moisture beyond field capacity to saturation further increased the volatilization of trifluralin. There was no significant increase in volatility of granular trifluralin or of either formulation of benfen with increasing soil moisture level (Figure 1). The commercial granular formulation of trifluralin had a volatility pattern similar to that of benfen, but there was significantly more trifluralin volatilized from a sprayed application at saturation than benfen (Figure 1). Granular formulations of chlorpropham (isopropyl *m*-chlorocarbamate) (10) and dichlobenil (2,6-dichlorobenzonitrile) (11) reduced vapor losses compared to spray applications, whereas granular formulations of EPTC (S-ethyl dipropylthiocarbamate) (4) and propanil (isopropyl carbamate) (10) resulted in similar vapor losses.

The volatility of trifluralin and benfen at a soil temperature of 40 C was greater than that which occurred at 30 C (Figures 1 and 2). Trifluralin volatility from a sprayed formulation was two to three times greater at field capacity or saturation than either a spray or granular formulation of benfen or the granular formulation of trifluralin. Volatility of trifluralin and benfen, either as a sprayed or granular formulation, increased significantly at 40 C as the moisture content of the soil was increased from air dryness to field capacity but did not increase significantly from field capacity to saturation (Figure 2). The vapor loss of trifluralin from a metal surface was approximately twice the volatility of benfen (Table 2).

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RESULTS AND DISCUSSION

Volatility. Increasing the soil moisture from air dryness to field capacity increased the volatilization during a 3 hr

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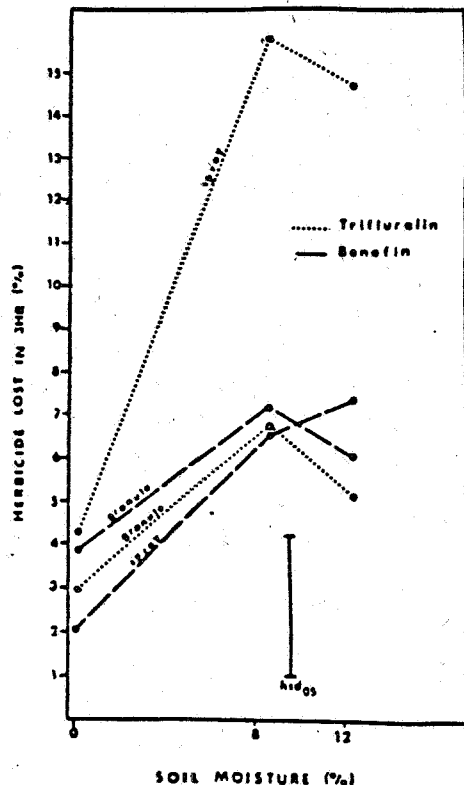


Figure 2. Trifluralin and benfen volatility from Lakeland sand at 40°C soil temperature as influenced by soil moisture and formulation.

Table 2. The effect of formulation on the volatility of trifluralin and benfen from a metal surface in 3 hr at 40°C and 0.04 m/hr air flow rate.

Herbicide	Percent herbicide lost ^a	
	Spray	Granular
Trifluralin	21.8 ^a	23.0 ^b
Benfen	12.6 ^a	9.7 ^a

^aAll means followed by the same letter do not differ significantly at the 5% level according to Duncan's multiple range test.

A granular formulation did not reduce trifluralin or benfen loss from a metal surface.

At a soil temperature of 50°C the volatility of trifluralin at field capacity and saturation was again statistically greater than benfen (Figure 3). The vapor loss of trifluralin after 3 hr was approximately 25% for trifluralin and 12.5% for benfen.

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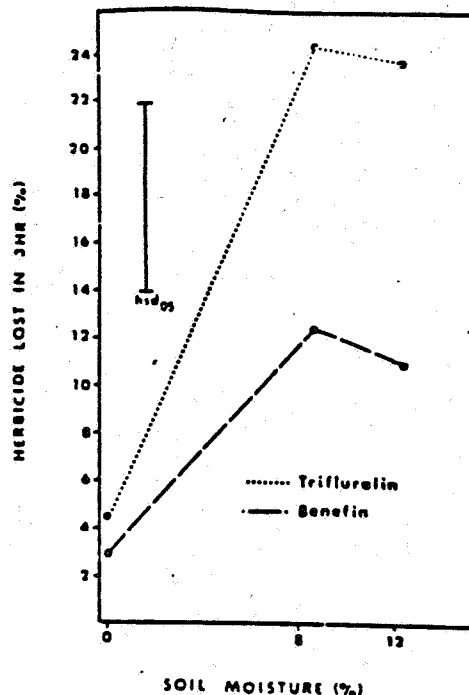


Figure 3. Trifluralin and benfen volatility from Lakeland sand at 50°C soil temperature as influenced by soil moisture.

Trifluralin as a spray application was approximately twice as volatile as benfen from soils at field capacity or saturation at all soil temperatures studied. Increasing the soil temperature resulted in an increase of vapor loss of trifluralin and benfen. Similar results have been reported for trifluralin (12), dichlobenil (11), chlorpropham and propanil (10).

Increasing soil moisture from air dryness to field capacity consistently resulted in an increase in trifluralin volatility at all soil temperatures studied. A similar increase for benfen occurred at a soil temperature of 40 and 50°C. Generally, increasing soil moisture beyond field capacity did not increase volatility of trifluralin or benfen. Speculation that moisture interferes with absorption of volatile herbicides has been previously advanced (4, 10, 11) and seems to fit this model.

No loss of nitratin was detected under any of the conditions studied. The gas chromatographic technique employed had a detection limit of 0.023 ng for nitratin. Empirically, nitratin was expected to be less volatile than benfen and trifluralin because the vapor pressure (mm Hg at 25 to 30°C) of nitratin (1.0×10^{-4}) is lower than that of benfen (38.9×10^{-4}) and trifluralin (114×10^{-4}).

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10⁻⁴) (13). It has been reported (3, 7) that nitratin is not volatile from soil.

The volatility of a sprayed formulation of trifluralin and benfen from three different soils at field capacity was also studied at 40 C soil temperatures (Figure 4). The volatil-

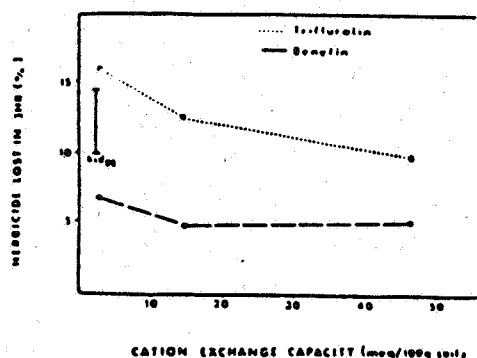


Figure 4. Trifluralin and benfen volatility from three soils at field capacity as influenced by cation exchange capacity. The three soils were Lakeland sand (29 meq/100 g of soil), Hagerstown loam (14.7 meq/100 g of soil), and Sharkey clay (46.4 meq/100 g of soil).

ity of trifluralin decreased as the cation exchange capacity of the soil increased. Statistically only the vapor loss of trifluralin from Lakeland sand was different from that of Sharkey clay. The loss of trifluralin was greater than benfen at each cation exchange level.

Photodecomposition. The photodecomposition of trifluralin, benfen, and nitratin were studied by analyzing the residual amount of herbicide remaining on soil following light exposure. The amount of trifluralin or benfen remaining following 24 hr of exposure to light as bioassayed was not significantly lower than a corresponding check held in the dark or from the zero time exposure; the zero-time bioassay indicated approximately 12 ppm of trifluralin or benfen in the soil (Figures 5 and 6). There was a trend downward in the amount of herbicide remaining when exposed to light, but this was not statistically different from the corresponding dark check.

There was no loss of activity of nitratin when exposed to light for 72 hr. Nitratin that was sprayed and bioassayed immediately was approximately 12 ppm and was not statistically different from any of the data presented in Figure 7.

Volatilization of trifluralin and benfen appears to be a more important means of dissipation from soil than photochemical degradation. A direct comparison can not be made between the volatility studies conducted for 3 hr and photodecomposition studies conducted for 24 and 72 hr. Within the same exposure period, there is no sig-

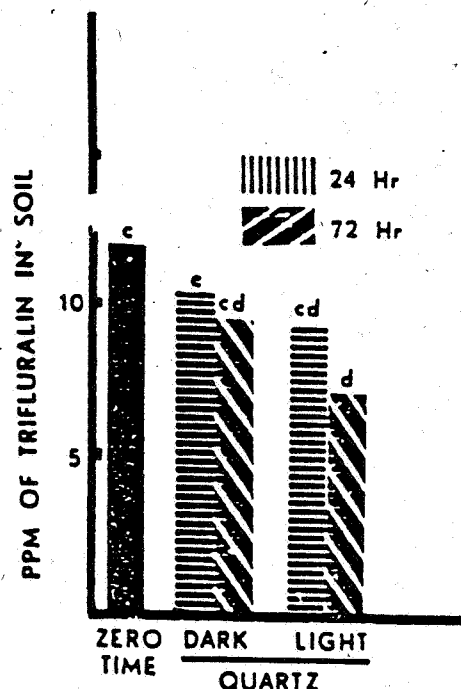


Figure 5. The amount of trifluralin remaining on Lakeland sand soil surface after 24 or 72 hr of exposure to darkness and light (ultraviolet) at 26 C. Columns having the same letters are not statistically different at the 5% level of probability according to Duncan's multiple range test.

nificant difference between dark and light radiated samples covered with quartz for trifluralin, benfen, or nitratin. Loss of trifluralin and benfen occurred when compared to the zero time sample in the photodecomposition studies, but this loss must be attributed to vapor loss from the edge of the quartz glass cover, microbial breakdown, or chemical decomposition. Trifluralin has been reported to photodecompose when radiated on glass surfaces (5, 12), in organic solvents (8, 9), or as a vapor (7). Although photodecomposition of trifluralin on a dry, uncovered soil surface has been reported, the rate of trifluralin dissipation when radiated on soil was greatly reduced when compared to radiated trifluralin on glass (14). In the present study, there was no positive evidence of photodecomposition of trifluralin, benfen, or nitratin when radiated on the soil surface. The soil being an uneven surface provides protection and alteration of direct radiation thus greatly minimizing photodecomposition.